2011 IEPR Committee Workshop on Energy Storage for Renewable Integration

Panel 2: Energy Storage Applications and Economics (Costs, Benefits and Revenue)

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INTELLIGENT STORAGE AT WORK.

Smart, Distributed Thermal Energy Storage

Cost-effective and commercially viable

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CESA
CALIFORNIA ENERGY STORAGE ALLIANCE

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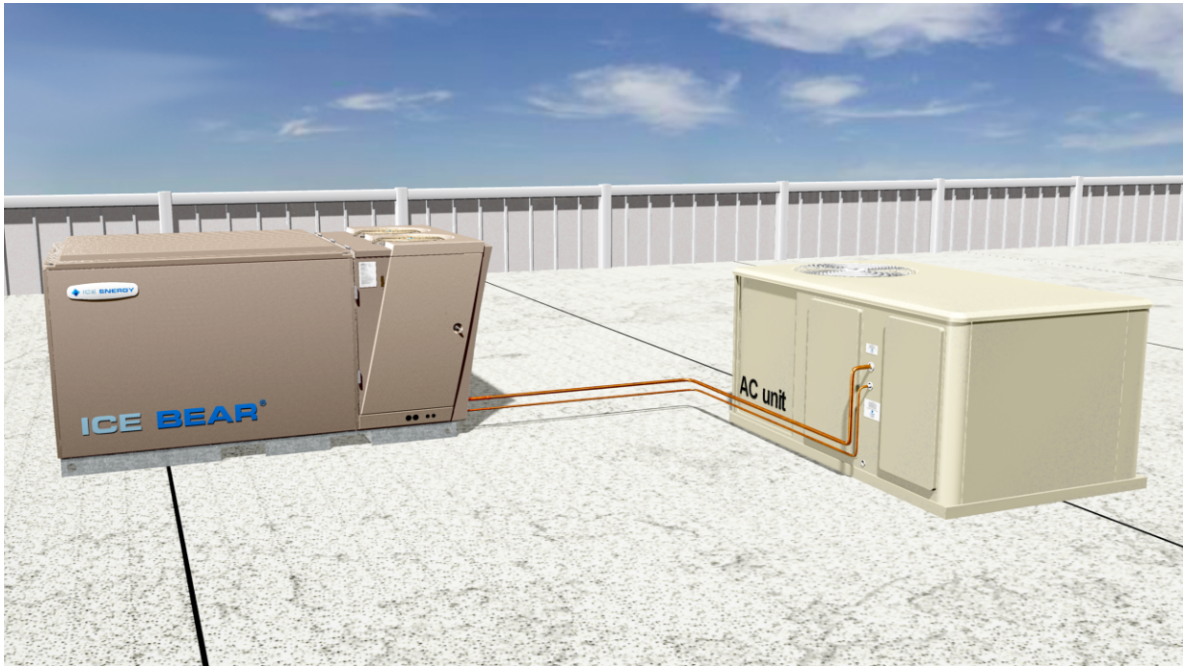
Smart, distributed energy storage is utility-scale



Distributed resources

Real-time control

Aggregated units managed as a single resource

Benefits of Distributed Energy Storage

Improves System Operations

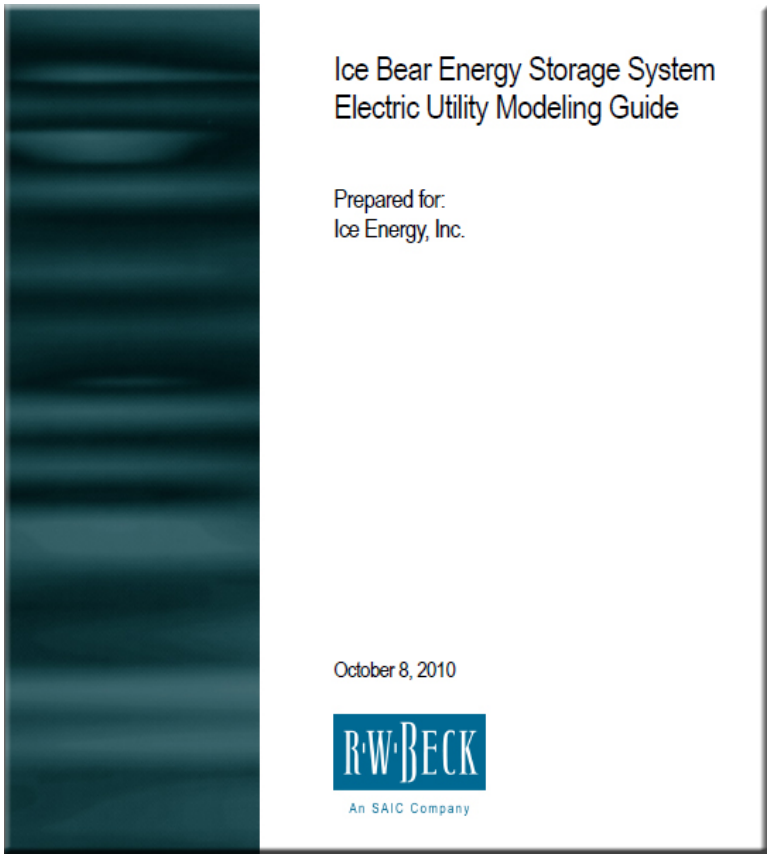
- ❑ Improved system efficiency
- ❑ Improved system power factor & voltage support
- ❑ Improved daily electric system load profile

Avoided Costs

- ❑ Avoided or delayed peakers/generators
- ❑ Avoided or delayed T&D system expenses
- ❑ Avoided electric system losses

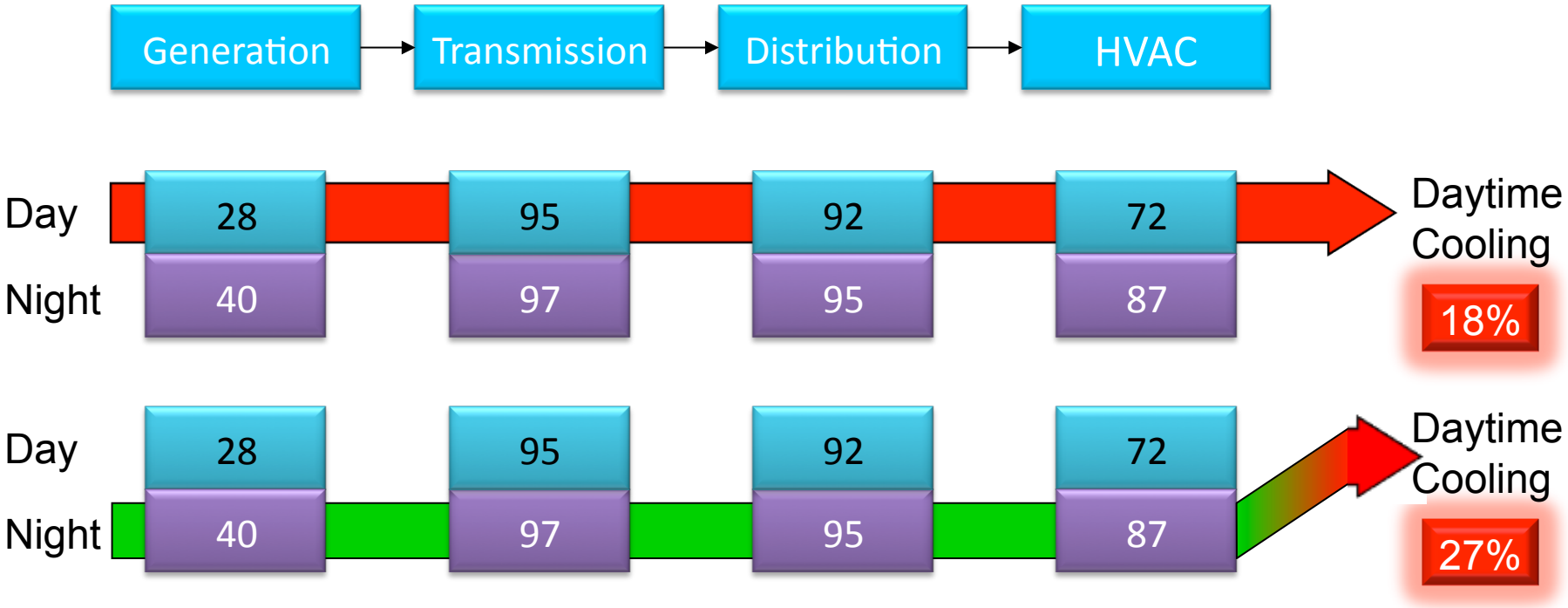
Enhances System Capacity

- ❑ Increased system power transfer capability
- ❑ Enhanced integration of renewable resources
- ❑ Eliminates fault-induced delayed voltage recovery (AC stalling)



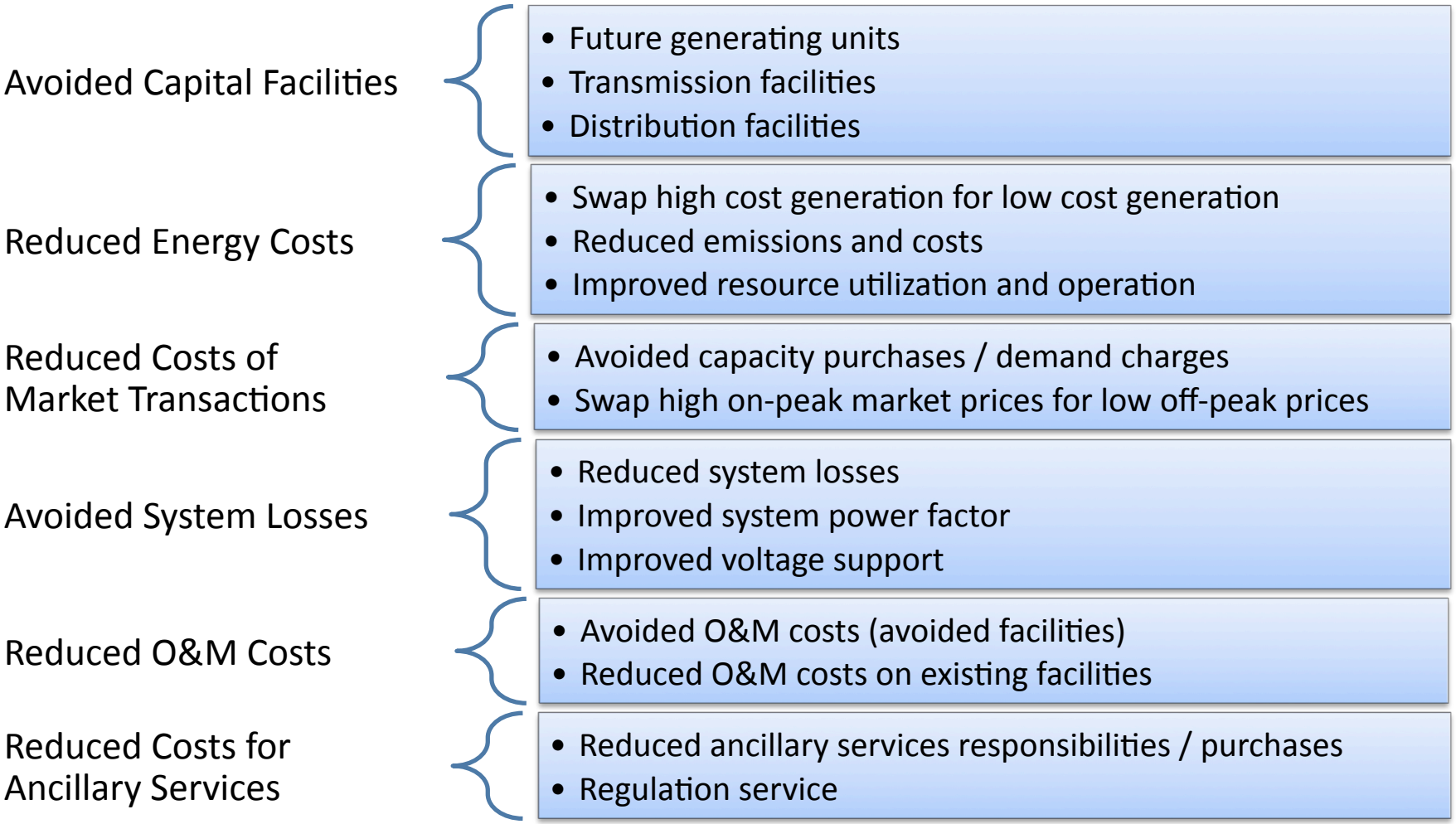
www.ice-energy.com/energy-storage-modeling-guide/

Power and Storage Efficiency and Cost Is Temperature- and Time-Sensitive



- *Ice Bear thermal storage uses fuel ~50% more efficiently (18% * 1.5 = 27%)*
- *Ice storage avoids interconnection issues, safety concerns, and conversion losses – uses water as a storage medium.*

Avoided Utility Costs



Value of Avoided Capacity

Avoided Generation Fixed Costs	Avoided per-unit ($/kW) capital cost of planned generating unit
	Avoided demand charges for power purchases
	Deferred generation expansion plan (with and without Ice Bear System)
	Fixed O&M costs of avoided/deferred generating units
Avoided T&D Fixed Costs	Average cost of historical or budgeted facilities (divided by load growth)
	Targeted T&D upgrades avoided or deferred by distributed storage
	Adjust for peak ambient conditions and losses
	Fixed O&M costs of avoided/deferred T&D facilities

Example of Equivalent Generating Capacity Calculation

	Adj. Factor	MW Rating
Ice Bear System Site Capacity at Design Conditions (95°F)		100
Ice Bear Rating at Peak Ambient Conditions (105°F)	15%	115
T&D Avoided Peak Demand Losses	12%	129
Capacity Planning Margin (Reserve Margin)	15%	148
Generator Rating at Peak Ambient Conditions (105°F vs. 60°F)	20%	178
Equivalent Generation Capacity (% of Ice Bear Capacity)	178%	

Example of Equivalent T&D Capacity Calculation

	Adj. Factor	MW Rating
Ice Bear System Site Capacity at Design Conditions (95°F)		100
Ice Bear Rating at Peak Ambient Conditions (105°F)	15%	115
Avoided Demand Losses (btwn site and avoided T&D facilities)	6%	122
Power Factor Adjustment (avoided load at 80% PF)	25%	152
T&D Design/Planning Margin	20%	183
Equivalent T&D Capacity (kVA as % of Ice Bear MW Capacity)	183%	

Other Utility Benefits

Enhanced integration of renewable resources	• Addition of more renewable resource capacity • Augment operation / dependability of renewable resources
Improved system efficiency & reliability	• Reduced average system heat rate • Improved system reliability
Increased potential for market sales	• *Frees-up* generation that can be sold during peak periods • Surplus capacity sale • Surplus energy sale
Natural hedge against power prices	• Swap high on-peak prices for low off-peak prices • Swap high on-peak volatility for low off-peak volatility
Reduced costs for fuel procurement	• Higher utilization of base / intermediate resources • Less reliance on peaking resources (higher cost fuel) • Better utilization of fuel reservations

Considerations and Recommendations re: Cost, Benefits and Revenues of Storage

- Needs to be a widely recognized cost-effectiveness methodology (inc. recognizing variances among storage technol./applications)
- Challenge of optimally and cheaply integrating renewables has to be fully recognized
- Need appreciation of Utility ownership of storage – to both decrease deployment costs and increase benefits
- Recognize that storage products often provide much more than just "traditional" storage services; the value of the other services – such as EE, direct load control, etc. – need to be factored in
- The multiple benefits of storage need to be aggregated up – it touches many departments/silos – including generation, transmission, distribution and demand-side